AIR ROUTES TO AUSTRALIA

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Lord Montagu, the authority on aëronautics, in a recent lecture on world air routes has said:[1]

> It is clear that meteorology and the study of wind currents is going to be of supreme importance. The knowledge of the world's atmospheric conditions and accurate forecasts, apart from their inherent scientific interest, may effect the saving or spending of millions of money annually, when postal and commercial aviation is established.

The advent of steam has decreased the economic importance of surface winds and currents, but the sailing ships in the Australian trade are still bound by weather laws and have only one route. They come from Africa to Australia, but return to Europe via Cape Horn. The reverse route, though possible, involves permanent head winds and unfavorable currents which remove it from the regions of economic trade. Much more will the air routes depend on the variations of weather and climate.

Upper Air Studies in the Past

The study of surface winds and of the general circulation of the atmosphere dates back to very early times, but it was first put on a firm basis in 1856 by Ferrel's and Maury's treatises. The first experimental investigations of upper currents, apart from the study of clouds, volcanic banners, etc., were made about 1890, and a little later the Hargrave box kite (invented in Australia) was used profitably in America for this purpose.

It is only in the last twenty years, however, that the exploration of the upper air has been carried out at all generally, but now research is world-wide. For instance, in 1911 Simpson first sent up sounding balloons in Antarctica (where the writer was initiated), and in 1913 and 1914 the upper air of Australia was investigated in the same way at Melbourne. The conditions over the northern regions of Australia are almost unknown, and we depend on Java for any knowledge that is available.

Like so many scientific experiments their immediate practical value was not obvious to the man in the street. Now that aviation, however, has come into its own, these explorations of the upper air have already proved of value. The United States government has devoted $100,000 to meteorological research connected with military aviation; and it is to be hoped that the military and political authorities of Australia will in the future show more interest in the matter than they have shown hitherto.

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[1] Lord Montagu: The World's Air Routes and Their Regulation (Paper Read Before the Aeronautical Society, June 21, 1917), *Flight*, No. 444, Vol. 9, 1917, pp. 653-659, London.

The Most Feasible Route to Australia

Let us now see which are the most promising routes to this isolated continent. The writer has given the matter considerable attention in his lectures at the Commonwealth Aviation School. In Figure 1 is given a somewhat unusual world map (on Sylvanus' projection) where the position of Australia with regard to the other continents is well brought out. Though the edges of the map are necessarily distorted, it shows us that Australia is situated in the center of the largest expanse of water in the

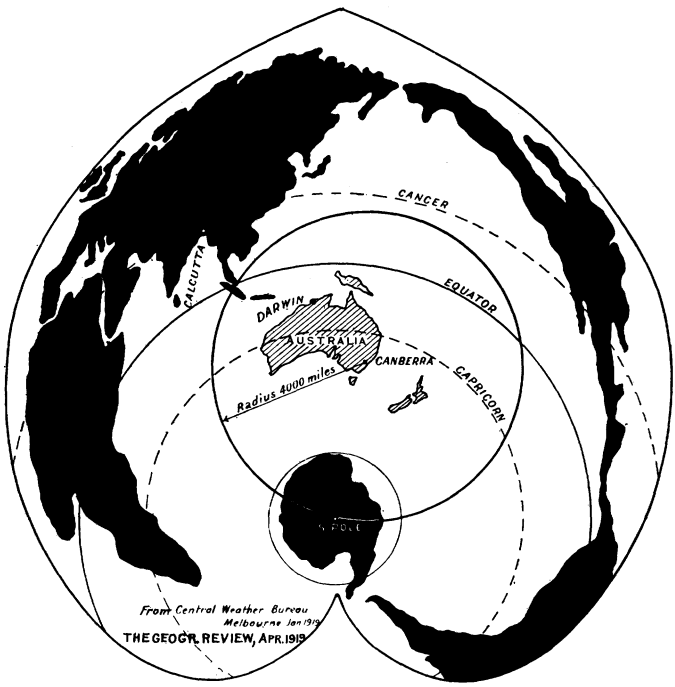

FIG. 1—World map on Sylvanus' projection showing the isolation of Australia. Scale, 1:292,500,000.

world, which we may term the Pacifico-Indian Ocean. This sheet of water is itself surrounded on all sides by land except to the south of Africa (for Antarctica entirely shuts off the waters to the south of Australia) and will for long prove an obstacle to flights from most of the continents.

If we draw a circle of 4,000 miles radius from Canberra (which is happily placed almost at the center of population of Australia), we find that it passes directly through Antarctica (near the South Pole) but includes none of the other large land masses. The nearest continent is therefore of little use as a flying station. Africa and the Americas are ruled out by distance; they are separated from Australia by 7,000 miles of water with but few islands in most directions. There remains, therefore, Asia; and it is by way of India and the Straits Settlements that the

first airplane services may be expected to travel. We have all read of the recent flights from England to India; they were accomplished with comparative ease in about four days. Such flights will soon become almost weekly occurrences.

Stations between Calcutta and Canberra

Nature has placed stepping-stones from India to Australia in the form of the drowned volcanic ranges, which are, of course, the islands of Sumatra, Java, and Timor; and these lead directly to Port Darwin, the chief settlement on the northern coast of Australia. I have drawn up a list of stations for an air route from Calcutta to Canberra with their distances. At all of these, except perhaps Koepang and Mataranka, there are, I believe, stores of petrol and facilities for repair (see Fig. 2).

As regards the time occupied, Lord Montagu in his paper on world air routes assumes about 1,200 miles a day as the average passenger-plane speed. Mr. G. Holt Thomas in a recent lecture before the Aeronautical Society of Great Britain[2] showed a map of the world crossed by air routes, where Sydney is only five days from England. This is twice as rapid as the recent flights and is probably much more rapid than the earlier services are likely to accomplish regularly. I have assumed 1,500 miles in 24 hours, which makes it about four days from Calcutta to Canberra, in case of favoring winds.

First Day	
Calcutta to Rangoon, Burma	650 miles
Rangoon to Bangkok, Siam	350
Bangkok to Penang, Malay States	580
	1,580
Second Day	
Penang to Singapore, Malay States	350
Singapore to Batavia, northwestern Java	560
Batavia to Banjoewangie, southeastern Java	520
	1,430
Third Day	
Banjoewangie to Koepang, Timor	680
Koepang to Port Darwin (only oversea stage)	500
Port Darwin to Mataranka (suggested inland capital, Northern Territory)	250
	1,430
Fourth Day	
Mataranka to Cloncurry	600
Cloncurry to Longreach	300
Longreach to Brisbane	600
	1,500
Fifth Day	
Brisbane to Sydney	500
or	
Brisbane to Canberra	600
or	
Brisbane to Melbourne	900

[2] G. H. Thomas: Commercial Aeronautics (Paper Read Before the Aeronautical Society, May 30, 1917), *Flight*, No. 440, Vol. 9, 1917, pp. 536-543, London.

The Trade Wind as a Factor

Let us look more particularly into the meteorological factors on this route. It lies almost entirely in the monsoon and trade wind region, whose climates differ materially from those to which most of us are accustomed.

The trade wind is a surface wind blowing from the southeast (over Australia) to the equator (see Fig. 3). Its limits vary during the year, for the belt is farther north in winter than in summer, moving with the sun. In the southern winter (July) these winds reach the equator, that is almost to Singapore, and will obviously hinder the airplane coming from India but will help the return flight. In the southern summer (Fig. 2) their influence is not felt much north of the Tropic of Capricorn, and only the last day's journey from India will be affected. In the northern hemisphere the trade winds blowing from the northeast will be cross winds in January and will be obliterated in July by the periodical monsoons.

Very little research on the limits of the trade winds either in height or in latitude has been done in the southern hemisphere, but the following notes embody what is available.

The trade wind in northern Queensland blows on an average about 20 miles an hour for weeks at a time, but its velocity is probably less in other portions of its belt. This steady drift can obviously affect very considerably the velocity of the plane. The layer of the trade wind is, however, of limited thickness, for above it blows a poleward return wind. This is reached about 12,000 feet above sea level near the tropics (according to German data) but is lower in temperate regions. It is often reached in ascending 4,000 feet above Melbourne, and high regions like Mt. Kosciusko experience the west wind very frequently. We know nothing directly of its depth in the Australian tropics.

These heights mentioned are quite those of the regular flight zones. Hence our air captain will doubtless fly from the equator to southern Australia at high levels when the surface winds in July are against him, in this permanent anti-trade region. At these elevations wind forces are much stronger, for there is little friction due to obstructions or turbulent eddies at heights above a mile. For instance, at the upper flight limit the winds in temperate latitudes have an average of about 60 miles an hour.

The Monsoon as a Factor

During the summer seasons in the region discussed there is the maximum development of monsoons. The strong southwest monsoon of India blows during the hot months and is accompanied by dense clouds, thunderstorms, and much rain. These winds are not favorable for aviation either in direction or in their accompanying meteorology; but here again they are confined to the lower 12,000 feet, and above this (as the Dutch have shown in Java) are found trade winds. The winter monsoon is practically the same as the trade wind.

In Australia the northwest monsoon blows in the northern regions during the three hottest months. It is a layer of turbulent wind, and probably the aviator will prefer to fly above it, though the dominant monsoon wind from the northwest would help him to the south. Its extent and character can at present only be surmised.

Where the sun is vertically overhead the air is rising, and these regions, though calm at the surface, are certainly turbulent areas in the flight zone.

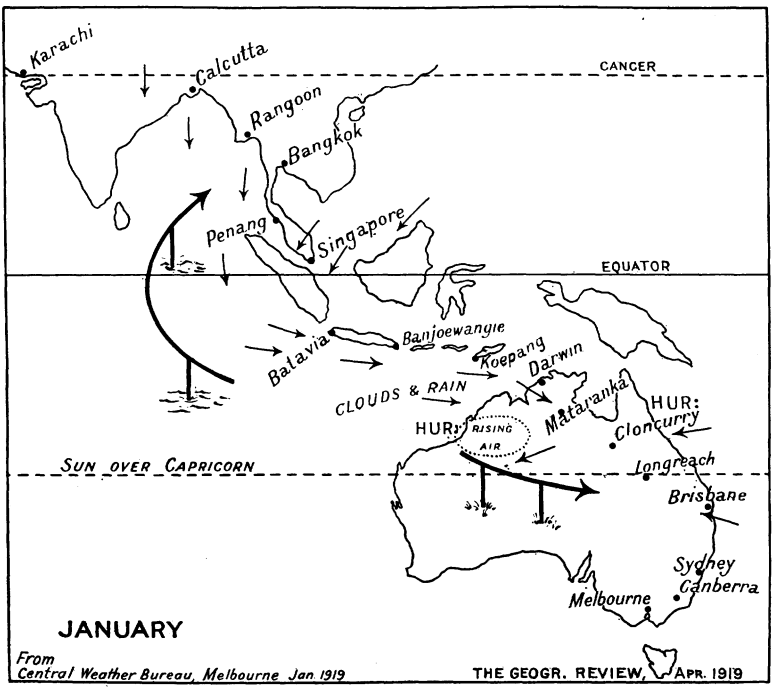

FIG. 2—Sketch map of Australasia showing the dominant winds in January. Equatorial scale, 1:100,000,000. The winds of the upper flying layers are shown on stilts. HUR=hurricane.

However, though heat bumps on a large scale may be apparent, they have not much significance for a modern plane and can be avoided by high flying.

OTHER METEOROLOGICAL CONDITIONS

The most violent storms of the tropics are the occasional hurricanes. Luckily these are confined to the oceans and rarely cause much damage far inland. They are prevalent in summer in the regions indicated, but airplanes flying overland will not often be dangerously affected. This is an unknown field of research, but one which it will be disastrous to neglect much longer.

The southern portion of Australia is dominated by anticyclones at the surface and by the westerly drift above. Here we are on more familiar

ground. The anticyclones are surrounded by variable winds, generally unimportant from the present point of view. They have clear skies and afford good flying weather. The aviator will be interested in the more intense lows (or cyclones) which periodically travel across southern Australia, but they are regularly forecast and should not catch him unprepared for their clouds, rain, and strong winds.

The writer began this article with a quotation and will conclude with

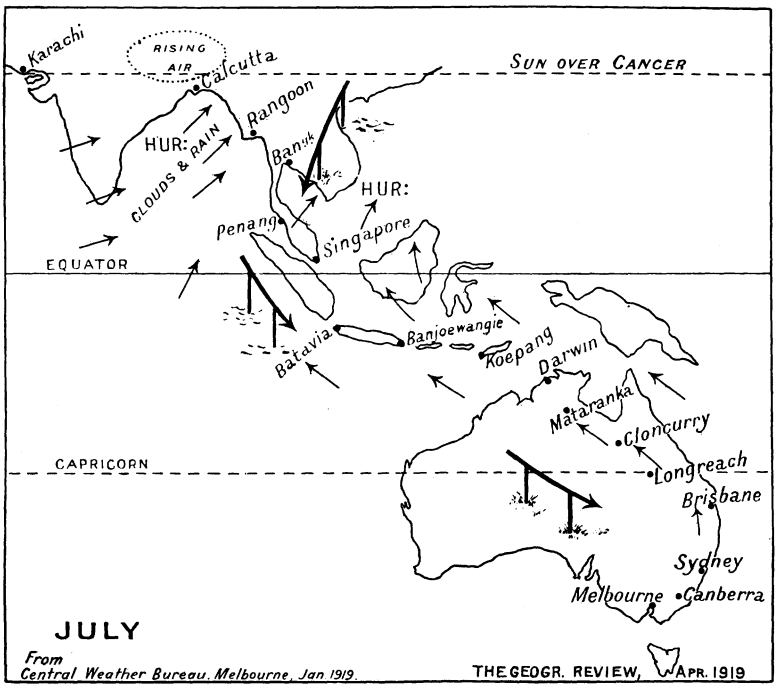

FIG. 3—Sketch map of Australasia showing the dominant winds in July. Equatorial scale, 1:100,000,000. The winds of the upper flying layers are shown on stilts. HUR=hurricane.

one. Lieutenant Colonel Mervyn O'Gorman in a note added to the Fifth Wilbur Wright Memorial Lecture stated:[3]

> Commercial aëronautics are bound up with using the [special] values which accrue incidentally to the employment of aircraft. I take three of these: (1) the speed of transit made available, (2) the directness of the route which can be selected, (3) the utilization of helpful winds and evading bad weather.

Much more might be written on this topic, but it is hoped that the reader will now realize how intimate is the connection between meteorology and aviation and also how much remains to be done in a scientific preparation for the forthcoming aërial traffic.

[3] Mervyn O'Gorman: Looking Ahead (Being the Fifth Wilbur Wright Memorial Lecture, Delivered Before the Aeronautical Society at Grafton Galleries, London, on June 13, 1917), *Flight*, No. 442, Vol. 9, 1917, pp. 599-603 and 629, London.